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EXAMINER

MIYOSHI, JESSE Y

ART UNIT	PAPER NUMBER
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2811

NOTIFICATION DATE	DELIVERY MODE
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ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 10/564,486	Applicant(s) SON, HYO-KUN	
	Examiner JESSE Y. MIYOSHI	Art Unit 2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 December 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 26-50 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 26-50 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claim 26 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. There is no support for amended claim 26 in the specification.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 26 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The wording of the claimed limitation “wherein In content with respect to Ga and In content of the active layer is greater than In content with respect to Ga and In content of the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer” is not clear. It reads as three separate statements:

- 1) “In content with respect to Ga”

2) "and In content of the active layer is greater than In content with respect to Ga";

3) "and In content of the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ ".

Examiner suggests this portion of the claim be re-written in a way to better describe the invention. Examiner is still unsure if the above portion of claim 1 is to mean that the In content is greater in the active layer compared to the multi-layer.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 26, 30, 31, 33, 34, 37, 38, 41-44, 47, 48 and 50 are rejected under 35 U.S.C. 102(b) as being anticipated by Emerson et al. (U.S. PGPub 2003/0020061; hereinafter "Emerson").

Re claim 26: Emerson teaches a light emitting device (figure 2), comprising: a first gallium nitride layer (**25**; paragraph 27); a second gallium nitride layer (**32**; paragraph 31) formed over the first gallium nitride layer (**25**); an active layer (**31**; paragraph 34) having an InGaN/InGaN structure of a multi-quantum well (MQW) structure (multiple quantum well **31** having alternating layers of $\text{In}_x\text{Ga}_{1-x}\text{N}$ and $\text{In}_y\text{Ga}_{1-y}\text{N}$; paragraphs 34 and 35) formed between the first gallium nitride layer (**25**) and the second gallium nitride layer (**32**); and an $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer (superlattice **27**

having alternating layers of InGaN with different mole fraction combinations of indium and gallium; paragraph 32) formed between the first gallium nitride layer (**25**) and the active layer (**31**) to intercept an applied electrostatic discharge, wherein In content with respect to Ga and In content of the active layer (table 1 shows that In % of the MQW structure using InGaN can be up to 30%) is greater than In content with respect to Ga and In content of the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer (table 1 shows that the preferred In% of the superlattice using InGaN is 15%).

Re claim 30: Emerson teaches the device wherein the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer is formed to have a super lattice structure (superlattice **27** having alternating layers of InGaN with different mole fraction combinations of indium and gallium; paragraph 32).

Re claim 31: Emerson teaches the device wherein each layer of the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer has a thickness of 1-3000Å (superlattice **27** is provided with alternating layers of InGaN having thickness of about 10Å; paragraph 32).

Re claim 33: Emerson teaches a light emitting diode (LED) (**20**; figure 2), comprising: a first gallium nitride layer (**25**; paragraph 27); an $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer (superlattice **27** having alternating layers of InGaN; paragraph 32) formed over the first gallium nitride layer (**25**); an active layer formed over the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer (**31**; paragraph 34); and a second gallium nitride layer (**32**; paragraph 31) formed over the active layer (**31**).

Re claim 34: Emerson teaches the LED wherein the active layer comprises an InGaN/InGaN structure of a multi-quantum well structure (active layer is a multiple

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quantum well **31** having alternating layers of $\text{In}_x\text{Ga}_{1-x}\text{N}$ and $\text{In}_y\text{Ga}_{1-y}\text{N}$; paragraphs 34 and 35).

Re claim 37: Emerson teaches the LED wherein the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer is formed to have a super lattice structure (superlattice **27** is provided with alternating layers of InGaN with different mole fraction combinations of indium and gallium; paragraph 32).

Re claim 38: Emerson teaches the LED wherein each layer of the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer has a thickness of 1-3000Å (superlattice **27** is provided with alternating layers of InGaN having thickness of about 10Å; paragraph 32).

Re claim 41: Emerson teaches the LED wherein the LED is blue LED (the present invention can produce higher-energy photons that fall in to the blue portions of the spectrum; paragraph 23).

Re claim 42: Emerson teaches a method for manufacturing a light emitting device (figure 2), the method comprising the steps of: forming an N-type gallium nitride layer (**25** doped to be n-type; paragraph 27); forming an $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer (superlattice **27** having alternating layers of InGaN with different mole fraction combinations of indium and gallium; paragraph 32) above the N-type gallium nitride layer (**25**), the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer (**27**) including layers of first and second growth temperatures (since it is well-known in the art that different growing temperatures of InGaN result in different In content, as also described by the applicant, where higher temperatures result in lower In content, superlattice structure **27** is comprised of alternating layers of InGaN with different mole fraction combinations of

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indium and gallium, it would be inherent that these two layers are formed at two different temperatures; paragraph 32); forming an active layer (**31**; paragraph 34) above the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer (**27**); and forming a P-type gallium nitride layer (p-type GaN layer **35**; paragraph 31) above the active layer (**31**), wherein the active layer is grown at a temperature lower than the first and second temperatures (as can be seen in table 1, InGaN layers of the MQW for the active layer are preferred to be grown at 770°C whereas the InGaN layers of the superlattice are preferred to be grown at 780°C).

Re claim 43: Emerson teaches the method wherein the active layer is grown at 600~800 °C (table 1 show MQW InGaN layers being grown at 770°C).

Re claim 44: Emerson teaches the method wherein the active layer comprises an InGaN/InGaN structure of a multi-quantum well structure (MQW **31** has layers of $\text{In}_x\text{Ga}_{1-x}\text{N}$ alternating with $\text{In}_y\text{Ga}_{1-y}\text{N}$ where $1 \geq X, Y \geq 0$; paragraphs 34 and 35).

Re claim 47: Emerson teaches the method wherein the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer is formed to have a super lattice structure (superlattice **27** having alternating layers of InGaN with different mole fraction combinations of indium and gallium; paragraph 32).

Re claim 48: Emerson teaches the method wherein each layer of the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer has a thickness of 1-3000Å (superlattice **27** is provided with alternating layers of InGaN having thickness of about 10Å; paragraph 32).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 27, 35 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Emerson as applied to claims 26, 33 and 42 above, respectively, and further in view of Edmond et al. (U.S. PGPub 2002/0195606; hereinafter "Edmond"). The teachings of Emerson have been discussed above.

Re claims 27, 40 and 50: Emerson is silent as to the active layer being directly formed on the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer.

Edmond teaches a superlattice structure **56** comprising alternating layers of $\text{In}_x\text{Ga}_{1-x}\text{N}$ and $\text{In}_y\text{Ga}_{1-y}\text{N}$ and an active region **60** comprising layers of $\text{In}_x\text{Ga}_{1-x}\text{N}$ where the barrier layers have less indium content than the well layers. The superlattice structure **56** has the MQW active region **60** placed directly on top of the superlattice structure **56** in order to enhance carrier concentrations as compared to bulk films (paragraphs 98-99).

It would have been obvious to one of ordinary skill in the art at the time of the invention modify the structure taught by Emerson having a gallium nitride layer provided between the superlattice and MQW active layer and have the superlattice structure provided directly below the MQW active layer as taught by Edmond in order to enhance carrier concentration as compared to bulk films (paragraph 94 of Edmond)

9. Claims 28, 35 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Emerson as applied to claims 26, 33 and 42 above, respectively, and further in view of Uchida ("Journal of Electronic Material: *Photoluminescence characteristics and pit formation of InGaN/GaN Quantum-Well structures Grown on Sapphire Substrates by Low-Pressure Metalorganic Vapor Phase Epitaxy*"). The teachings of Emerson have been discussed above.

Re claims 28, 35 and 45: Emerson is silent as to the device wherein the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer has a plurality of pits formed thereon.

Uchida teaches InGaN-based quantum-well (QW) structures, where a single QW surface had pits with an average diameter of 20nm and pit density was estimated to be on the order of $6 \times 10^7 \text{cm}^{-2}$ (paragraph 3 of the results and discussion).

It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Emerson and Uchida to result in a light emitting device/LED to have pits formed on InGaN-based multi-layer structure having an average density of $2 \times 10^8 \text{cm}^{-2}$ or less and would have the benefit of high-quality InGaN-based QW structures may be developed (paragraph 3 of introduction of Uchida)

10. Claims 29, 36 and 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Emerson modified by Uchida as applied to claims 28, 35 and 45 above, respectively.

Re claims 29, 36 and 46: Emerson is silent as to the device wherein the number of the pits is 50 or less per area of $5\mu\text{m} \times 5\mu\text{m}$ (which is roughly $2 \times 10^8\text{cm}^{-2}$). The teachings of Emerson have been discussed above.

Uchida teaches InGaN-based quantum-well (QW) structures, where a single QW surface had pits with an average diameter of 20nm and pit density was estimated to be on the order of $6 \times 10^7\text{cm}^{-2}$ (paragraph 3 of the results and discussion).

It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Emerson and Uchida to result in a light emitting device/LED to have pits formed on InGaN-based multi-layer structure having an average density of $2 \times 10^8\text{cm}^{-2}$ or less and would have the benefit of high-quality InGaN-based QW structures may be developed (paragraph 3 of introduction of Uchida)

11. Claims 32, 39 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Emerson as applied to claims 26, 33 and 42 above, respectively, and further in view of Kim et al. ("Mat. Res. Soc. Symp. Proc. Vol. 722 Materials Research Society: *Structural and Optical Properties of InGaN/GaN Multi-Quantum Well Structures with Different Well Widths*"; hereinafter "Kim"). The teachings of Emerson have been discussed above.

Re claims 32, 39 and 49: Emerson is silent as to the device wherein the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer has a photoluminescence characteristic of a yellow band intensity/N-doped GaN intensity ratio of 0.4 or below.

Kim teaches an InGaN/GaN MQW structure having various well widths each width having an effect on the photoluminescence (PL) characteristics. Kim teaches the intensity ratio of the yellow band to the peak intensity varied according to the well thickness and for a well width of 6nm, the yellow band to peak intensity ratio was 0.4 (page K7.12.5 and figure 5 Inset).

It would have been obvious to one of ordinary skill in the art at the time of the invention to vary the well width, as taught by Kim, of the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ multi-layer as taught by Emerson to obtain a yellow band to peak intensity ratio to be 0.4 or below. By keeping the well width below 6nm, the yellow band to peak intensity would therefore be below 0.4, allowing the device to have the benefit of a higher emission intensity (abstract of Kim et al. page K7.12.1).

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U.S. PGPub 2002/0175341 to Biwa et al. teaches the common knowledge of the art in that in order to obtain a higher In content in InGaN, the growth temperature will be lower compared to InGaN grown at a higher temperature; paragraph 54. U.S. 6,614,059 to Tsujimura et al. teaches pits created in GaInN/GaN MQW structure having densities as high as 10^8 (column 1, lines 41-43).

13. Applicant's arguments with respect to claims 26-50 have been considered but are moot in view of the new ground(s) of rejection.

14. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JESSE Y. MIYOSHI whose telephone number is (571)270-1629. The examiner can normally be reached on M-F 7:30AM-5:00PM EST. Alternating Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynne A. Gurley can be reached on (571) 272-1670. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Carl Whitehead Jr./
Supervisory Patent Examiner, Art
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JYM